ABSTRACT

A methodology for process modeling and control and the software system implementation of this methodology, which includes a rigorous, nonlinear process simulation model, the generation of appropriate linear models derived from the rigorous model, and an adaptive, linear model predictive controller (MPC) that utilizes the derived linear models. A state space, multivariable, model predictive controller (MPC) is the preferred choice for the MPC since the nonlinear simulation model is analytically translated into a set of linear state equations and thus simplifies the translation of the linearized simulation equations to the modeling format required by the controller. Various other MPC modeling forms such as transfer functions, impulse response coefficients, and step response coefficients may also be used. The methodology is very general in that any model predictive controller using one of the above modeling forms can be used as the controller. The methodology also includes various modules that improve reliability and performance. For example, there is a data pretreatment module used to pre-process the plant measurements for gross error detection. A data reconciliation and parameter estimation module is then used to correct for instrumentation errors and to adjust model parameters based on current operating conditions. The full-order state space model can be reduced by the order reduction module to obtain fewer states for the controller model. Automated MPC tuning is also provided to improve control performance.